



## Research Center for Wireless Information Networks (WINLAB)

Rutgers, The State University of New Jersey

*Advancing the future of wireless communications through education and research*

### Center Mission and Rationale

Little more than a decade ago, before the introduction of cordless and cellular telephones, the majority of Americans had had little experience with radio communications. Today, more than 35 million people in the United States use cellular telephones, and perhaps twice that number use cordless telephones. The ability to communicate without the tether of a wire has become natural and commonplace, and is being expanded rapidly into new environments. Radio is delivering on its promise of communications "anywhere." Simultaneously, information networks have evolved which direct an explosion of data into our communication systems; and increasingly this information will find mobile users at its endpoints. Today's telephone and personal computer will merge into an "information appliance," offering all forms of information to the untethered user.

Despite this image of seamlessness, however, communications will traverse a variety of wireless systems, interconnected by wideband backbone networks. Even today a number of competing technologies, standards, and services have emerged, and their number can be expected to increase. A focus

of the Research Center for Wireless Information Networks (WINLAB) is to understand and evaluate these competing options, both individually and as interacting elements of a global network.

### Research Program

This focus links dozens of research projects, clustered in six Study Groups that reflect WINLAB expertise in a variety of fields related to wireless communications and mobility.

- Advanced architectures and radio technologies are addressed by the **Network Architecture Study Group** and the **Multiple Access Study Group**. A principal challenge facing these groups today is multimedia communications — i.e., creating networks that simultaneously and optimally handle speech, data, images, and video. Advanced versions of Time-Division Multiple Access (TDMA) and Code-Division Multiple Access (CDMA), as well as Asynchronous Transfer Mode (ATM), are included in the studies.
- Two Study Groups concentrate on network control strategies for mobile information systems, applying theoretical tools to improving service quality and system efficiency. The **Radio Resource Manage-**

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Experimental models of future wireless communications technologies figure prominently in WINLAB teaching and research.



**WINLAB workshops provide an opportunity for exchanging ideas with researchers from around the world.**

**ment Study Group** brings together techniques for channel allocation, power control, handoff, and admission control. The **Mobility Management Study Group** is concerned with the prompt, efficient delivery of information to moving terminals.

- The **Mobile Computing Study Group** creates and implements new applications for the networks under consideration in the other Study Groups. In contrast to today's computer services, available on the Internet and elsewhere, these applications will have to overcome the special challenges imposed by the radio environment, including the limited available power and the mobility of the user.
- The **Infostations Study Group** explores a novel system design which delivers high volumes of information to mobile terminals as they pass through "islands" of high-bandwidth radio coverage. This new approach to information delivery raises a wide range of issues including service definition, protocols, radio design, and economics. It forms the basis of a new graduate course that stresses the interdisciplinary nature of system creation.

#### **Special Center Activities**

WINLAB has a strong influence on education in communications technology at Rutgers University and elsewhere, and maintains a concurrent focus on information

transfer to industry. From an initial course in "Wireless Access to Information Systems" in the spring of 1989, Rutgers has continued to add new courses at the graduate and undergraduate level which reflect the WINLAB focus and systems viewpoint. Educational materials developed at Rutgers have been adapted to serve the needs of WINLAB sponsors.

- Stimulated by WINLAB, Rutgers now offers a Certificate in Wireless Communications in conjunction with graduate degrees in Electrical and Computer Engineering. WINLAB workshops on Third Generation Wireless Information Networks, held every 18 months, attract international experts who are creating technologies for the communication networks of the next century, and weekly seminars at WINLAB attract both students and practicing engineers.
- Under the Internship Program, students obtain summer or other positions at the sites of our sponsors. Under the Visiting Scholar Program, sponsor employees spend time at WINLAB, working with WINLAB researchers.
- WINLAB sponsors include more than 25 companies representing telecommunications research, systems manufacturers, and service providers in the United States and other countries, as well as the U.S. Army's Communication Command.

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